CONFERENCE OF THE COMMITTEE ON DISARMAMENT

CCD/430
12 July 1974
Original: ENGLISH

JAPAN

Working Paper containing views of Japanese experts on the scope of prohibition and on the verification for organophosphorus compounds for the informal meetings with participation of experts of the CCD in 1974

I. The scope of prohibition

Annex I, deriving from Article IV of the "Draft Convention on the Prohibition of the Development, Production and Stockpiling of Chemical Weapons and on Their Destruction" which was submitted by the delegation of Japan on April 30, 1974 (CCD/420), is expected to list, in the schedule, chemical agents provisionally suspended from the prohibition (Alternative A) or chemical agents to be prohibited from the beginning (Alternative B). Therefore, the content of the schedule will cause the scope of prohibition to vary at the first stage; however the scope should be determined by the adequacy of applied verification. In this connexion, in view of the present feasibility of effective verification measures, which is to be discussed in part II of this working paper, it will be realistic to list super-toxic organophosphorus compounds, among others, as chemical agents to be prohibited from the beginning, whether or not we adopt I (A) or I (B). Our views on the schedule of Annex I are as follows:

1. Annex I (A) will list chemical agents provisionally suspended from the prohibition, namely, chemical agents other than the super-toxic organophosphorus compounds which are not used for peaceful purposes. One way of selecting these chemical agents may be to adopt the toxicity level of chlorine as a lower threshold, as suggested in the Canadian working paper (CCD/414) and in the Swedish working paper (CCD/427) and to list dual purpose chemical agents, placing organophosphorus compounds having the equivalent toxicity level of Lct_{50} = 20,000 mg. min/m^3 on a lower threshold. However it must be noted that there is a difficulty in adopting this way in that few data have been disclosed concerning the inhalent toxicity value of organophosphorus compounds. This difficulty will be eliminated if more data are disclosed in some way or another or if it is agreed to replace it with the toxicity value determined by some other administration route such as the toxicity value determined by intraperitoneal administration, about which many data have already been published.

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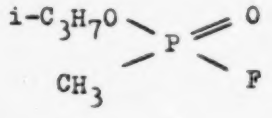
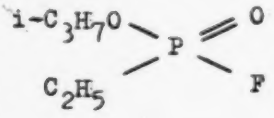
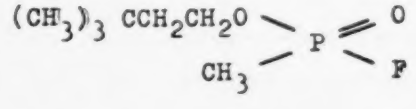
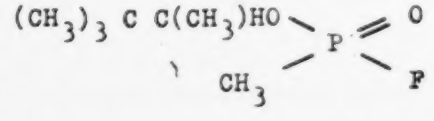
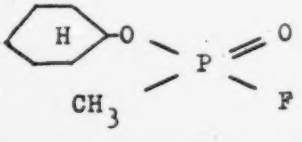
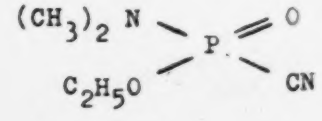
2. Annex I (B) is to list the chemical agents to be prohibited from the beginning, i.e., certain super-toxic organophosphorus compounds. In listing these, it is necessary to take into consideration three criteria: (i) a toxicity level (LD_{50} = 0.62 mg/kg i.p., LD_{50} = 0.50 mg/kg S.C.) that Japan has suggested as an objective criterion; (ii) chemical formulae; (iii) whether or not chemical agents have no peaceful use. Mainly by the first two criteria, we have chosen, from published data, super-toxic organophosphorus compounds to be prohibited from the beginning and listed some of them as an example in Table I.

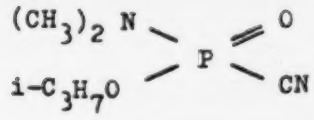
In selecting the agents falling in these criteria, questions may arise concerning the ways of dealing with high toxic chemical agents used for peaceful purposes and not known to be used at present for military purposes, but which could potentially be used for the latter (e.g., Echothiophate used for medicine). It may seem illogical to list chemical agents for peaceful purposes in the schedule insofar as Article I adopts purpose criteria, but, on the other hand, it may also be argued that they should be listed as dual purpose chemical agents in view of their potentiality of being used for military purposes. In any case, whether or not we list them under the category of the prohibited chemical agents depends upon our judgement concerning the degree of their potentiality of being used for military purposes.

With regard to the toxicity level, the problem of international standardization concerning procedures of estimating lethal dose has yet to be solved. However, it will be made possible to make a list of chemical agents to be prohibited by selecting the lowest LD_{50} value, measured under the condition that the same species and the same administration routes are employed, out of LD_{50} values which have been reported and may be reported in the future.

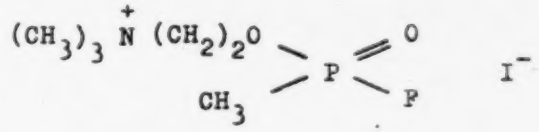
Table 1. Some supertoxic organophosphorus compounds to be listed in the schedule to Annex I (B)

No.	Chemical Name (Code Name) Chemical Formula
1.	Isopropyl methyl phosphonofluoridate (Sarin, GB) 
2.	Isopropyl ethyl phosphonofluoridate (Ethyl Sarin,GE) 
3.	3,3-Dimethylbutyl methyl phosphonofluoridate 
4.	Pinacolyl methyl phosphonofluoridate (Soman) 
5.	Cyclohexyl methyl phosphonofluoridate (GF) 
6.	Ethyl N,N-dimethyl phosphoramidocyanidate (Tabun) 

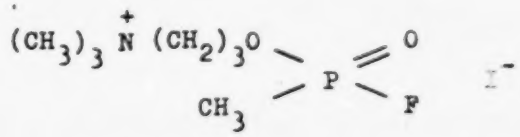
7. Isopropyl N,N-dimethyl phosphoramidocyanidate



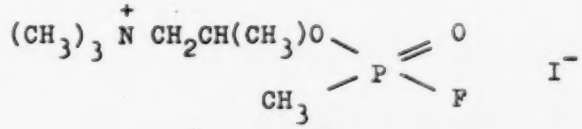
8. 2-Trimethylammoniumethyl methyl phosphonofluoridate iodide



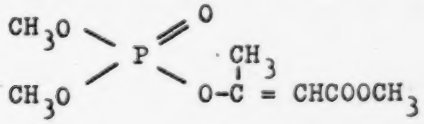
9. 3-Trimethylammoniumpropyl methyl phosphonofluoridate iodide



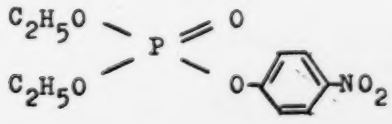
10. 2-Trimethylammonium-1-methylethyl methyl phosphonofluoridate iodide



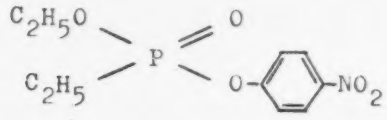
11. Dimethyl 1-methyl-2-carbomethoxyvinyl phosphate (α -phosdrin)



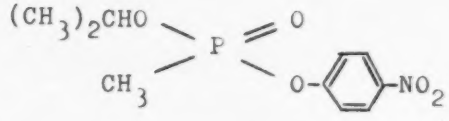
12. Diethyl 4-nitrophenyl phosphate (Paraoxon, E-600, Mintacol)



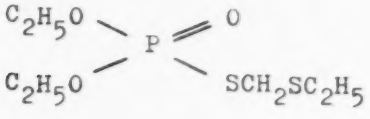
13. Ethyl 4-nitrophenyl ethylphosphonate (Armin)



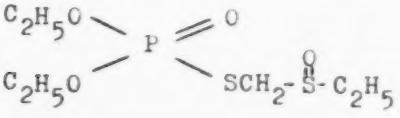
14. Isopropyl 4-nitrophenyl methylphosphonate



15. O,O-Diethyl S-ethylthiomethyl phosphorothioate



16. O,O-Diethyl S-ethylsulphinylmethyl phosphorothioate



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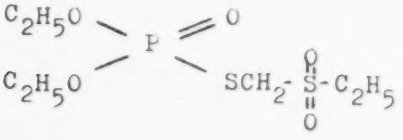
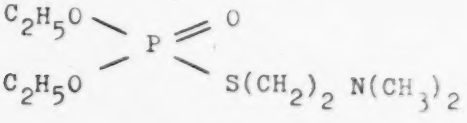
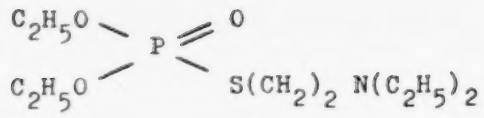


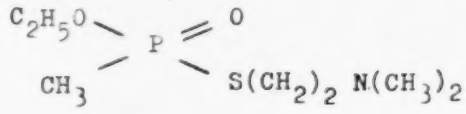
18. O,O-Diethyl S-(2-dimethylaminoethyl) phosphorothioate (217 AO)



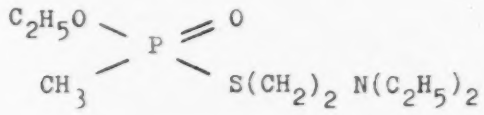
19. O,O-Diethyl S-(2-diethylaminoethyl) phosphorothioate (Tetram, DSDP)



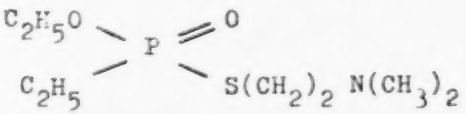
20. O-Ethyl S-(2-dimethylaminoethyl) methylphosphonothiolate (33 SN)



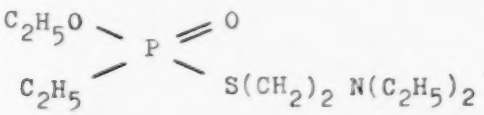
21. O-Ethyl S-(2-diethylaminoethyl) methylphosphonothiolate (Edemo, VM)



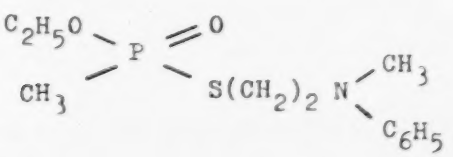
22. O-Ethyl S-(2-dimethylaminoethyl) ethylphosphonothiolate



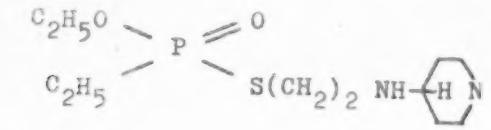
23. O-Ethyl S-(2-diethylaminoethyl) ethylphosphonothiolate (VE)



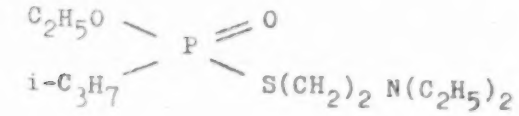
24. O-Ethyl S-(2-methylphenylaminoethyl) methylphosphonothiolate (GT 23)



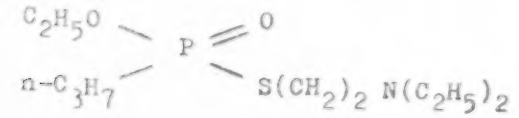
25. O-Ethyl S-(2-piperidylaminoethyl) ethylphosphonothiolate



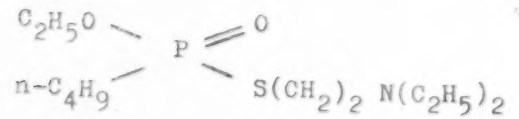
26. O-Ethyl S-(2-diethylaminoethyl) i-propylphosphonothiolate



27. O-Ethyl S-(2-diethylaminoethyl) n-propylphosphonothiolate



28. O-Ethyl S-(2-diethylaminoethyl) n-butylphosphonothiolate



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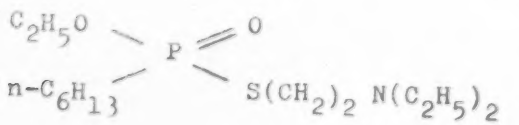
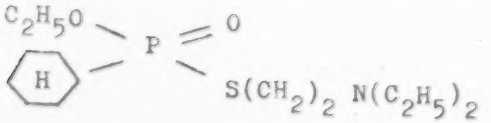
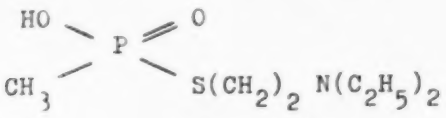


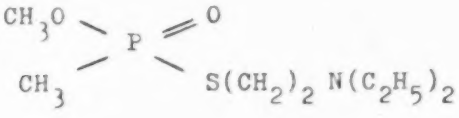
30. O-Ethyl S-(2-diethylaminoethyl) cyclohexylphosphonothiolate



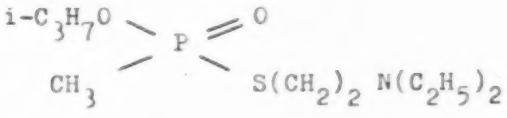
31. O-Hydrogen S-(2-diethylaminoethyl) methylphosphonothiolate (S 27)



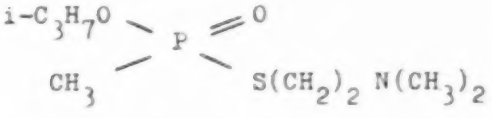
32. O-Methyl S-(2-diethylaminoethyl) methylphosphonothiolate



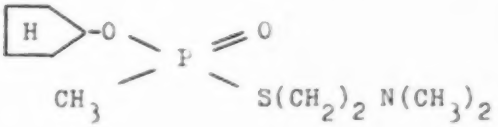
33. O-Isopropyl S-(2-diethylaminoethyl) methylphosphonothiolate (37 SN)



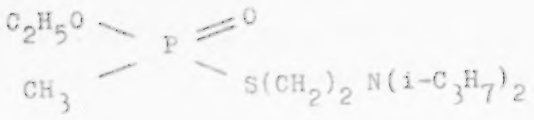
34. O-Isopropyl S-(2-dimethylaminoethyl) methylphosphonothiolate



35. O-Cyclopentyl S-(2-dimethylaminoethyl) methylphosphonothiolate



36. O-Ethyl S-(2-diisopropylaminoethyl) methylphosphonothiolate



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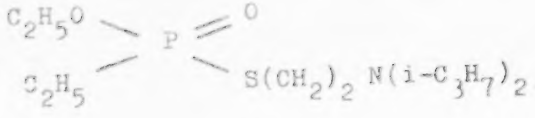
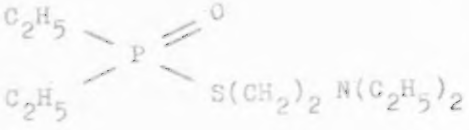
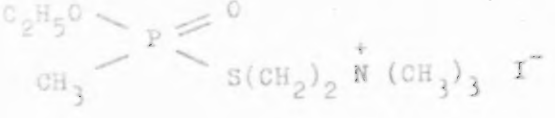


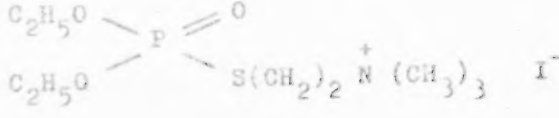
38. 2-Diethylaminoethylthio diethyl phosphine oxide



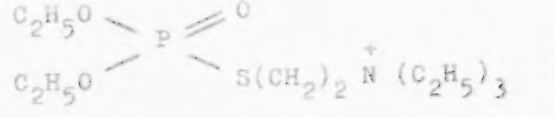
39. O-Ethyl S-(2-trimethylammoniumethyl) methyl-phosphonothiolate iodide



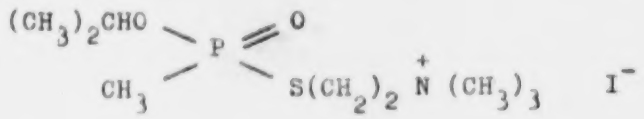
40. O,C-Diethyl S-(2-trimethylammoniumethyl) phosphorothioate iodide (Echothiophate, Phospholin)



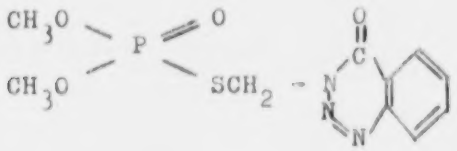
41. O,O-Diethyl S-(2-triethylammoniumethyl) phosphorothioate iodide



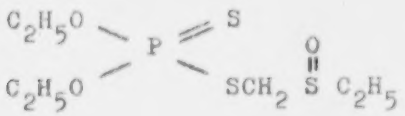
42. O-Isopropyl S-(2-trimethylammoniumethyl) methylphosphonothiolate iodide



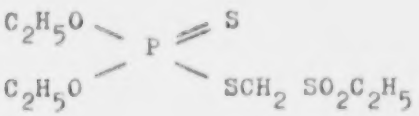
43. O,O-Dimethyl S-(4-oxo-3-H-1,2,3-benzotriazine-3-methyl) phosphorothioate (Guthion)



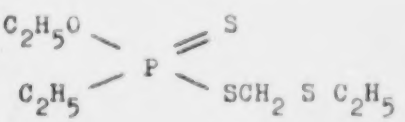
44. O,O-Diethyl S-ethylsulphinylmethyl phosphorodithioate



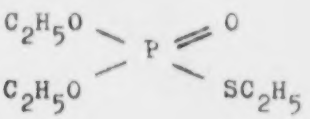
45. O,O-Diethyl S-ethylsulfonylmethyl phosphorodithioate



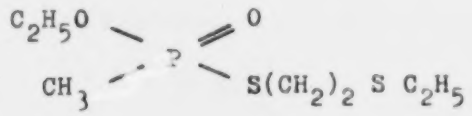
46. O-Ethyl S-(ethylthiomethyl) ethylphosphonodithioate



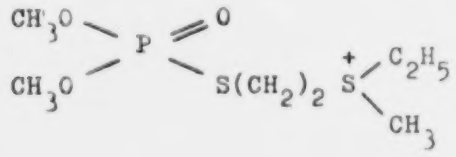
47. O,O-Diethyl S-ethyl phosphorothioate



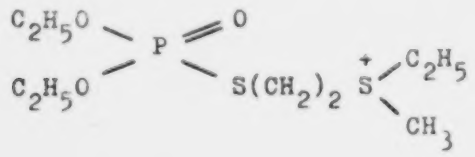
48. O-Ethyl S-(2-ethylthioethyl) methylphosphonothioate



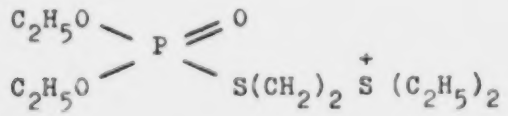
49. O,O-Dimethyl S-[2-(S'-methyl-S'-ethylsulfonium) ethyl] phosphorothioate



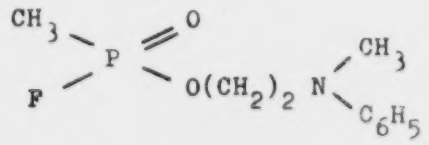
50. O,O-Diethyl S-[2-(S'-methyl-S'-ethylsulfonium) ethyl] phosphorothioate



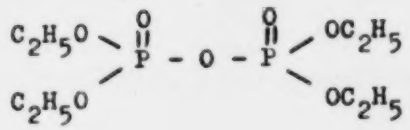
51. O,O-Diethyl S-[2-(S'-diethylsulfonium)ethyl] phosphorothioate



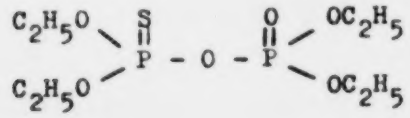
52. O-(2-N-methyl-N-phenylamino)ethyl methyl phosphonofluoridate



53. Tetraethyl pyrophosphate (TEPP)



54. Tetraethyl monothionopyrophosphate



II. Verification of super-toxic organophosphorus compounds.

1. Various methods of verification which have so far been suggested in working papers and other forms by many countries can be classified and summarized in the following table.

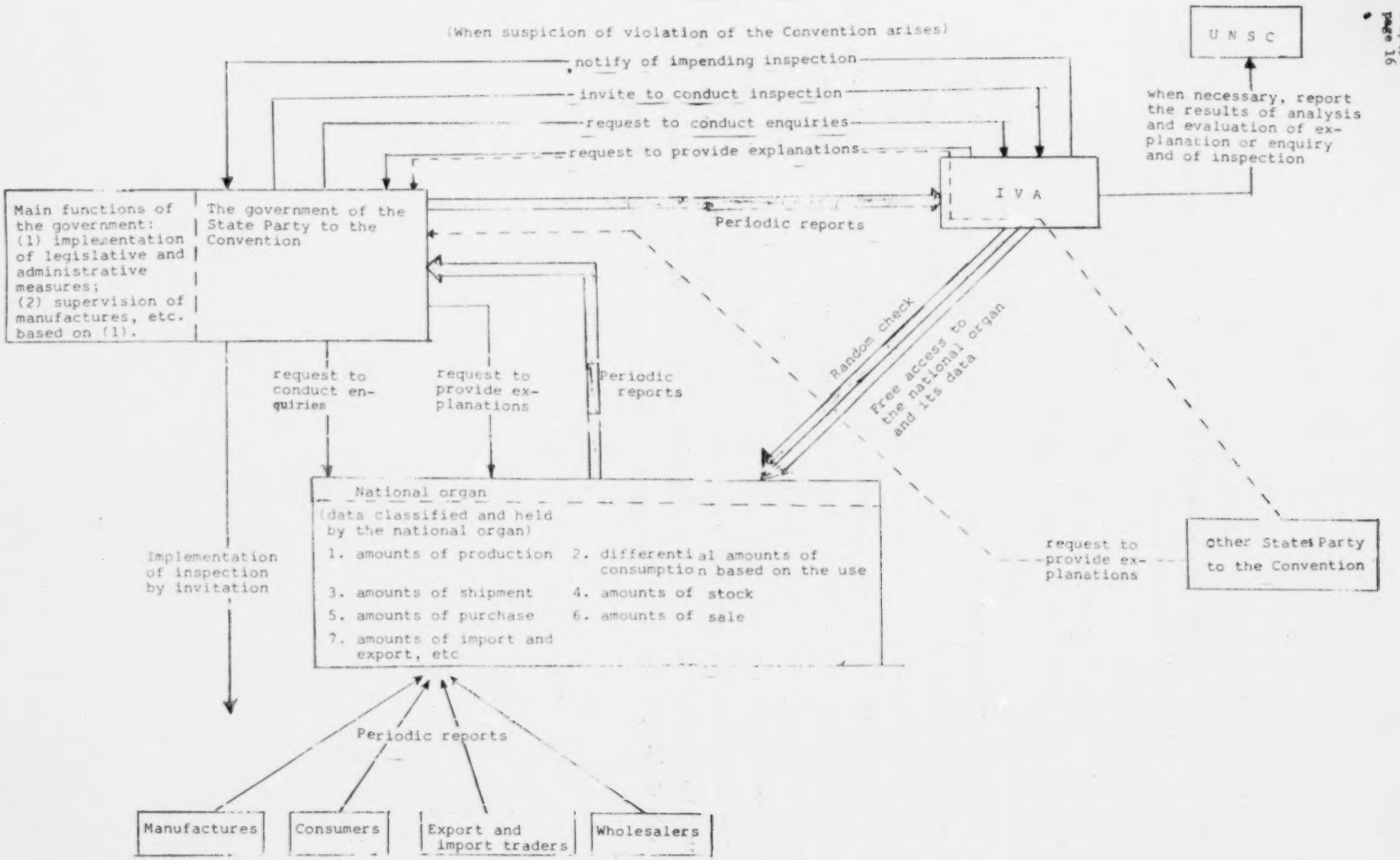
Table 2. Relationship between Verification Modes and Verification Techniques

Verification Modes		Details of Verification Technique
On-site Inspection	Methods of Verification	Example
(I) Direct Inspection (II) Indirect Inspection (III) Inspection by Invitation	(1). Investigation of Production, Equipment and Facilities etc.	Experts from, for example, the IVA, etc., will investigate: the production-process, their equipment and facilities, and production control etc.
	(2). Investigation of safety control on production etc.	Experts from, for example, the IVA, etc., will investigate: the safety control on production equipment and facilities, and workers health control (e.g., measurement of cholinesterase activities) etc.
	(3). Sampling and subsequent analysis	Application of the following analytical techniques Gas-chromatography, Infrared- and Ultraviolet-spectrophotometry, other chromatographic techniques (T.L.C. etc.), Nuclear-magnetic resonance, Mass-spectrometry, etc.
	(4). Investigation of records and data	Investigation of the following records and data; (1). the amounts of production, consumption, and loss in industry of the raw-materials and intermediates for CW-agents. (2). records of budgets for production (3). records of accidents in factories
	(5). Oral inquiry and questionnaires	Oral interrogation of and questionnaires answered by industry workers, managers, administrators. etc.
	(6). Investigation of the surroundings of industries.	(1). Sampling and subsequent analysis of the surroundings of industries. (2). Questionning the inhabitants of the surrounding areas of industries. (3). External observation of industries by photographic reconnaissance. etc.
Verification methods other than on-site Inspection	(1). Remote Observation (remote sensors)	Monitoring by satellite and by neighbouring countries, etc.
	(2). Statistical Reporting Systems	(1). Analysis of economic data involving the amounts of production, consumption, exports and imports for the raw-materials and the intermediates of CW-agents. (2). Analysis of the related data which should be submitted, etc.
	(3). Surveillance of literatures	Surveillance of related information, as well as various literatures, including patent literature, such as chemical engineering, pyrotechnics, meteorology and military equipment, etc.
	(4). Budgetary Investigation (5). Inquiry of records and data (6). Inquiry by questionnaire	Investigation and inquiry of the records and data which the national organ has, and interrogation by questionnaire of all employees, e.g., administrators, managers, technicians, workers, etc., of the national organ. etc.
	(7). Others	

2. By choosing a good combination of the verification measures shown above or by taking certain steps which would supplement one verification measure, the most effective results in checking violations will be obtained. This has been recognized by a SIPRI publication as well as by the working papers of Japan (CCD/301), the United States (CCD/311, CCD/368), Italy (CCD/373), Yugoslavia (CCD/377), Sweden (CCD/395) and the Socialist Countries (CCD/403).

However, the crux of the matter lies in the need to satisfy two conflicting requirements: to obtain verification results reliable enough to be able to deter the non-compliance of the Convention and at the same time to minimize the burden of States Parties to the Convention. From this point of view the Japanese draft convention (CCD/420) places its major emphasis upon verifications other than inspection, considering non-intrusive verifications as supplementary measures. As for "Remote Observation (sensors)" in "Verification methods other than on-site inspection", of the Table 2 shown above, it depends much upon further technological development. Therefore, of the "verification methods other than on-site inspection", (2) to (6) are expected to play a major role for the time being. An example of verification measures which the Japanese draft convention foresees can be depicted in the following chart.

Chart of an example of verification measures


(When suspicion of violation of the Convention arises)
notify of impending inspection
invite to conduct inspection
request to conduct enquiries
request to provide explanations
U N S C
when necessary, report the results of analysis and evaluation of explanation or enquiry and of inspection
I V A
Main functions of the government: (1) implementation of legislative and administrative measures; (2) supervision of manufactures, etc. based on (1).
The government of the State Party to the Convention
Periodic reports
Random check
Free access to the national organ and its data
request to conduct enquiries
request to provide explanations
Periodic reports
National organ
(data classified and held by the national organ)
1. amounts of production
2. differential amounts of consumption based on the use
3. amounts of shipment
4. amounts of stock
5. amounts of purchase
6. amounts of sale
7. amounts of import and export, etc
request to provide explanations
Other States Party to the Convention
Implementation of inspection by invitation
Periodic reports
Manufactures
Consumers
Export and import traders
Wholesalers

3. As shown in the above chart, the reporting system of statistical data constitutes the keystone of the draft convention (CCD/420). However, as pointed out in the United States' working paper (CCD/311, CCD/368), this reporting system involves the following problems:

(1) Errors of statistical data are unavoidable;

(2) Statistical data vary irregularly in the course of years;

(3) Methods of collecting data differ depending upon countries;

(4) There exists time lag in data collected.

In addition, there is the more important problem of ensuring the credibility of data.

(1) and (2) above are essentially unavoidable and accordingly, have to be left aside tentatively. (3) and (4) can be solved to some extent through the unification by the International Verification Agency (IVA) of the methods of collecting and reporting data. As for the credibility of data, in the field of statistics, the credibility of data is obtained through the method of random check, and hence, it would be necessary to adopt this method in banning chemical weapons. In this sense, it would be necessary to ensure the right of free access by the IVA to various data possessed by the national organ.

In order that the reporting system may be adopted as one of the verification measures, study on its concrete contents must first be made. (For instance, a SIPRI Monograph entitled "Chemical Disarmament: Some Problems of Verification" provides excellent guidance as a concrete example of useful verification measures. By the same token, working papers of the socialist countries (CCD/403), the United States (CCD/311) and Italy (CCD/373), etc., contain useful suggestions). Generally speaking, among activities involving chemical weapons -- development, production, stockpiling, destruction, etc., production is considered to be the most susceptible to verification measures. This is because production covers considerably wide areas, normally from the unloading of raw materials or intermediate products to the loading of the end products, and also because production contains many aspects which become the objects of verification such as administration of production, safety, and labour and such as measures for preventing environmental contamination. In other words, production contains a variety of elements which can be used for verification. Accordingly, in studying the reporting system on organophosphorus compounds, emphasis should be placed on production. (This

assertion is also made in working papers and in suggestions concerning verification so far put forward to the CCD by many countries. Outside the CCD, likewise, detailed study was made regarding the possibility of verifying the production of organophosphorus compounds at the symposium held by SIPRI in 1971).

Based on these considerations, the report to be submitted from each State Party to the IVA must grasp the movement from the unloading of raw material or intermediates to the loading of end products -- of the following 7 substances, which are thought to be closely related to the production of organophosphorus chemical warfare agents: (This is also suggested in Japan's working paper (CCD/301 of 1970, which proposed verification measures including the establishment of the reporting system.

(1) Yellow phosphorus; (2) phosphorus trichloride; (3) phosphorus oxychloride; (4) phosphorus pentachloride; (5) phosphorus pentasulfide; (6) dimethyl phosphite; (7) methyl phosphoryl dichloride.

At the CCD in the summer of 1971, Japan tabled a working paper (CCD/344) introducing statistical data which indicated the amounts of final respective uses of phosphorus trichloride and phosphorus oxychloride as well as their proportions to the whole amount. According to this working paper, the amounts of respective uses of phosphorus trichloride were; agricultural and sterilizing chemicals 2714t; vinyl chloride stabilizer 1229t; dyestuffs 642t; medicine 99t; others 353t. They totaled 5037t. Furthermore, the latest rough figures obtained unofficially and from disclosures at academic symposiums have led to the analysis of the "others" mentioned above as fire-resistent chemicals, antioxidant, catalyzer, agent for chlorination, etc., which amounted to 316-356t, thus identifying more than 90 per cent of the "others".

In view of the above, the Japanese experts propose the formulation of the Figure "Differential amounts of consumption based on the use of raw material and intermediates" and Table 3 "Statistical data of production, imports, consumption and shipment of raw materials and intermediates". The aforementioned Figure would be useful immediately in checking the amounts of raw material and intermediates; how the raw material and intermediates are used is not entirely known. Likewise, Table 3 would be useful in checking the balance between the input and output of raw material and intermediates. Logically, this Figure and Table 3 are mutually related and the overall evaluation of them is expected to strengthen the credibility of the economic data and could serve as an effective means of verification. In order

to further increase the credibility, the economic data to be reported from each State Party to the IVA should include, in addition to the items indicated in the Figure and in table 3, the list of facilities producing the aforementioned 7 types of raw material and intermediates and the production capabilities of States; priority consideration should be given to the inclusion of this list.

Admittedly, more careful study should be made concerning the contents of the report, mainly with a view to increasing the credibility of statistical data. At the same time, the data to be possessed by the national organ in formulating the report must be those which are tenable as the basis of data or items reported to the IVA and which can render the report convincing. Accordingly, the national organ would be required to receive a monthly report containing considerably detailed data from the facilities dealing with the above-mentioned 7 types of raw material and intermediates. The minimum content of such a monthly report would be as follows:

(1) Importers; amounts imported.

(2) Producers; amounts produced, amounts loaded, amounts in stock, and production capabilities.

(3) Wholesalers; amounts purchased, amounts sold.

(4) Users; amounts purchased.

(5) Exporters; amounts shipped.

The IVA must be given the right of free access to the national organ so that it may check the above-mentioned records and data.

In order to enhance the verification effects as much as possible, studies should be made as to how these data can be made as detailed and timely as possible and also as to the use of some parameters for the purpose of cross-checking in the fields of software, such as environmental protection, labour administration, etc.

Figure Differential amounts of consumption based on the use of raw material and intermediates

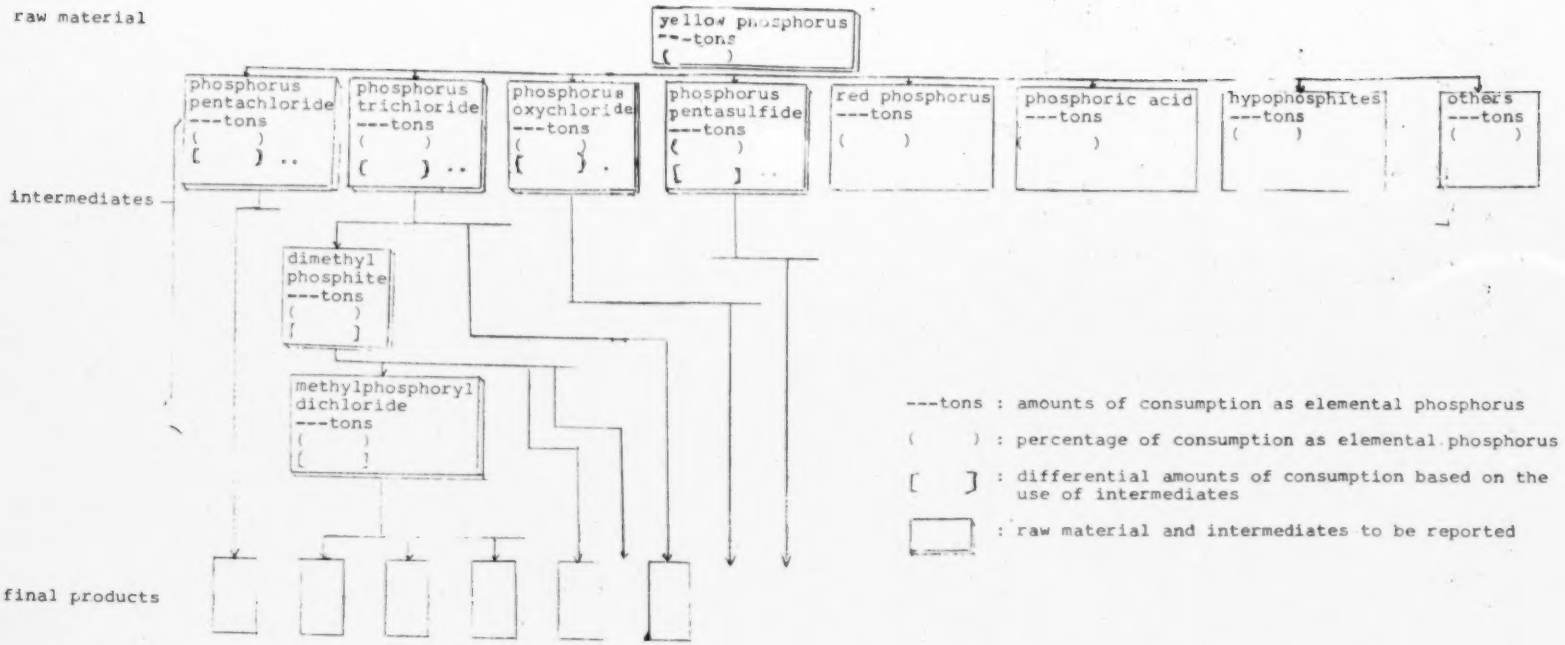


Table 3. Statistical data of production, imports, consumption & shipment of raw material & intermediates.

(ton/year)

amounts of seven substances		year			
		X	x + 1	X + 2	X + 3
yellow phosphorus	amount of stock at the end of the previous financial year amount of production amount of imports				
	total				
	amount of consumption amount of shipment amount of stock at the end of the present financial year				
	total				
phosphorus trichloride	the same as above				
phosphorus oxychloride					
phosphorus pentachloride					
phosphorus pentasulfide					
dimethyl phosphite					
methylphosphoryl dichloride					